DETERMINING pH AND SOLUBLE SALTS OF SOILS

(An Arizona Method)

SCOPE

1. (a) This test method describes the procedure for determining the pH and soluble salts content of soils.

(b) This test method may involve hazardous material, operations, or equipment. This test method does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user to consult and establish appropriate safety and health practices and determine the applicability of any regulatory limitations prior to use.

(c) See Appendix A1 of the Materials Testing Manual for information regarding the procedure to be used for rounding numbers to the required degree of accuracy.

(d) Metric (SI) units and values are shown in this test method with English units and values following in parentheses. Values given for metric and English units may be numerically equivalent (soft converted) for the associated units, or they may be given as rounded or rationalized values (hard converted). Either the metric or English units along with their corresponding values shall be used in accordance with applicable specifications. See Appendix A2 of the Materials Testing Manual for additional information on the metric system.

APPARATUS

2. Requirements for the frequency of equipment calibration and verification are found in Appendix A3 of the Materials Testing Manual. Apparatus for this test procedure shall consist of the following:

(a) Drying apparatus. - Any suitable device capable of drying samples at a temperature not exceeding 60 °C (140 °F).

(b) 100 mL glass beaker or other suitable non-metallic container.

(c) 250 mL glass beaker or other suitable non-metallic container.

(d) 200 mL minimum capacity cylinder graduated in 1 mL increments.

(e) Richards or Buchner funnel.

(f) Vacuum source.

(g) Conductance meter.

(h) Conductivity cell (Cell constant = 1.0/centimeter preferred).

(i) Distilled water.

(j) pH meter and combination probe, both having a relative accuracy of ± 0.05 pH units, minimum. The pH meter must be capable of registering a minimum pH range of 4.0 - 10.0, and be equipped with temperature compensation controls.

(k) Standard buffer solutions of pH values 4.0, 7.0, and 10.0. The expiration date of the solution shall be noted on the container. Solution shall not be used past the expiration date.

(l) 2.36 mm (No. 8) sieve conforming to AASHTO Designation M 92.

(m) A balance or scale capable of measuring the maximum weight to be determined and conforming to the requirements of AASHTO M 231, except the readability and sensitivity of any balance or scale utilized shall be at least 1 gram.

(n) Thermometer. - A thermometer accurate to 0.5 °C (1 °F).

(o) Miscellaneous mixing tools and pans.

SAMPLE PREPARATION

3. Prepare the sample according to the following procedure:

(a) The soil sample as received from the field shall be dried thoroughly in air or the drying apparatus at a temperature not exceeding 60 °C (140 °F).

(b) A representative test sample of approximately 500 grams shall then be obtained by splitting or quartering.

(c) Screen the test sample through a 2.36 mm (No. 8) sieve.

(d) From the screened pass 2.36 mm (No. 8) material, split out approximately 250 grams for the soluble salts test and approximately 50 grams for the pH test.

(e) Place the pH sample in the 100 mL beaker and add an equal weight of distilled water. Stir until well mixed and then stir at regular intervals of 8 to 10 minutes for an hour.

(f) The temperature of the standard buffer solutions must be within 10 °C of the pH sample. Also, temperatures of the standard buffer solutions and the pH sample must be within the manufacturer's recommended temperature compensation range of the pH meter.

(g) Prepare a saturated soil paste from the soluble salts test sample by placing the soil in the 250 mL beaker. Begin adding distilled water and stirring with a spatula. From time to time tap the container on a work bench to consolidate the soil-water mixture. At saturation, the soil paste glistens as it reflects light, flows slightly when the container is tipped, and slides freely and cleanly off the spatula except for soils containing much clay. Allow the sample to stand overnight and then recheck the preceding criteria for saturation. Free water should not collect on the soil surface nor should the paste stiffen markedly or lose its glistening appearance on standing. If this occurs, remix with more water.

TEST PROCEDURE FOR pH

4. (a) Per the manufacturer's instructions, standardize the pH meter using two of the standard buffer solutions: 7.0 and either 4.0 or 10.0, <u>whichever is nearest to the estimated pH of the sample</u>.

(b) For <u>each</u> standard buffer solution, measure its temperature and adjust the temperature controller of the pH meter <u>before</u> testing for the standard solution pH value. This may not be needed on meters with automatic temperature compensation; follow manufacturer's instructions.

(c) Stir the slurry mixture mixture in the 100 mL beaker. Measure the temperature of the slurry and adjust the temperature controller of the pH meter <u>before</u> testing for the pH value of the slurry. This may not be needed on meters with automatic temperature compensation; follow manufacturer's instructions.

(d) Carefully insert the pH probe in the slurry mixture. Determine the pH reading when the meter reading stabilizes.

(e) If the pH reading is unstable when the electrode is immersed in the soil slurry, leave the electrode immersed until the pH reading has stabilized. In some cases, the waiting period for stabilization of the pH reading may take up to 5 minutes.

(f) Record the pH value of the soil mixture, to the nearest tenth.

TEST PROCEDURE FOR SOLUBLE SALTS

5. Transfer the saturated soil paste to a filter funnel with a filter paper in place and apply vacuum until air begins to pass through the filter. Collect the extract in a bottle or test tube. Determine the temperature of the extract. Insert the conductivity cell into the extract, and determine electrical conductance. If the conductance falls above the highest range on the conductance meter, dilute the extract to one-tenth its original concentration of salts by diluting one part extract with 9 parts of distilled water. (The conductance reading obtained on the diluted extract must then be multiplied by ten since the conductance of the diluted extract is one-tenth the conductance of the original extract.)

CALCULATIONS FOR SOLUBLE SALTS

6. (a) If conductance reading was taken in units other than microsiemens, convert it to conductance in microsiemens. For example, if reading was taken in millisiemens, multiply the reading by 1000 to convert to conductance in microsiemens.

(b) Convert conductance to electrical conductivity, expressed as microsiemens per centimeter, by multiplying by the cell constant.

(c) Correct the conductivity at the test temperature to conductivity at 25°C (77 °F), by the following formula:

$$EC_{25} = (EC) \times (f_t)$$

Where: EC_{25} = Electrical conductivity (microsiemens/cm), corrected for 25 °C.

EC = Electrical conductivity (microsiemens/cm), at test temperature.

f_t = Factor obtained from Figure 1.

(d) Calculate the soluble salts content in parts per million (ppm) by the following formula:

$$\text{Soluble Salts (ppm)} = (EC_{25}) \times (0.64)$$

(e) Report the soluable salts to the nearest 10 ppm.

°C	°F	f_t	°C	°F	f_t	°C	°F	f_t
3.0	37.4	1.709	22.0	71.6	1.064	29.0	84.2	0.925
4.0	39.2	1.660	22.2	72.0	1.060	29.2	84.6	0.921
5.0	41.0	1.613	22.4	72.3	1.055	29.4	84.9	0.918
6.0	42.8	1.569	22.6	72.7	1.051	29.6	85.3	0.914
7.0	44.6	1.528	22.8	73.0	1.047	29.8	85.6	0.911
8.0	46.4	1.488	23.0	73.4	1.043	30.0	86.0	0.907
9.0	48.2	1.448	23.2	73.8	1.038	30.2	86.4	0.904
10.0	50.0	1.411	23.4	74.1	1.034	30.4	86.7	0.901
11.0	51.8	1.375	23.6	74.5	1.029	30.6	87.1	0.897
12.0	53.6	1.341	23.8	74.8	1.025	30.8	87.4	0.894
13.0	55.4	1.309	24.0	75.2	1.020	31.0	87.8	0.890
14.0	57.2	1.277	24.2	75.6	1.016	31.2	88.2	0.887
15.0	59.0	1.247	24.4	75.9	1.012	31.4	88.5	0.884
16.0	60.8	1.218	24.6	76.3	1.008	31.6	88.9	0.880
17.0	62.6	1.189	24.8	76.6	1.004	31.8	89.2	0.877
18.0	64.4	1.163	25.0	77.0	1.000	32.0	89.6	0.873
18.2	64.8	1.157	25.2	77.4	0.996	32.2	90.0	0.870
18.4	65.1	1.152	25.4	77.7	0.992	32.4	90.3	0.867
18.6	65.5	1.147	25.6	78.1	0.988	32.6	90.7	0.864
18.8	65.8	1.142	25.8	78.5	0.983	32.8	91.0	0.861
19.0	66.2	1.136	26.0	78.8	0.979	33.0	91.4	0.858
19.2	66.6	1.131	26.2	79.2	0.975	34.0	93.2	0.843
19.4	66.9	1.127	26.4	79.5	0.971	35.0	95.0	0.829
19.6	67.3	1.122	26.6	79.9	0.967	36.0	96.8	0.815
19.8	67.6	1.117	26.8	80.2	0.964	37.0	98.6	0.801
20.0	68.0	1.112	27.0	80.6	0.960	38.0	100.2	0.788
20.2	68.4	1.107	27.2	81.0	0.956	39.0	102.2	0.775
20.4	68.7	1.102	27.4	81.3	0.953	40.0	104.0	0.763
20.6	69.1	1.097	27.6	81.7	0.950	41.0	105.8	0.750
20.8	69.4	1.092	27.8	82.0	0.947	42.0	107.6	0.739
21.0	69.8	1.087	28.0	82.4	0.943	43.0	109.4	0.727
21.2	70.2	1.082	28.2	82.8	0.940	44.0	111.2	0.716
21.4	70.5	1.078	28.4	83.1	0.936	45.0	113.0	0.705
21.6	70.9	1.073	28.6	83.5	0.932	46.0	114.8	0.694
21.8	71.2	1.068	28.8	83.8	0.929	47.0	116.6	0.683

FIGURE 1